ABSTRACT

The present invention includes methods of performing *ex vivo* expansion of gene-modified hematopoietic stem cells which are useful for many applications involving bone marrow transplantation and *ex vivo* gene therapy. The present invention further includes the gene-modified hematopoietic stem cells that are used and produced by such methods. Such gene-modified hematopoietic stem cells can also contain a second heterologous gene. In addition, the present invention also includes methods of engrafting the gene-modified hematopoietic stem cells of the present invention into animals, including for *ex vivo* gene therapy and for reconstitution of hematopoietic cells in ablated mammals. The present invention also provides a method of isolating stem cells.